Medical School Hotline

Ryuzo Yanagimachi, PhD
"A World Class Scientist"

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The Japan Academy of Sciences bestowed upon Dr. Ryuzo Yanagimachi the world renowned "International Prize for Biology" for 1996. It is an annual award given to an individual who "has made an outstanding contribution to the advancement of research in fundamental biology." The award ceremony was conducted in Tokyo on November 25, 1996 in the presence of the Emperor and Empress of Japan.

This recognition has brought great pride, not only to the School of Medicine and the University of Hawaii, but also to his colleagues, his former students and postdoctoral fellows from all over the world who have studied with him.

Who is this scientist named Dr. Yanagimachi or affectionately known as "Yana"? He was a founding member of the Department of Anatomy when the John A. Burns School of Medicine was newly established in 1966. He was an assistant professor assigned a primary role to enhance and focus the department's research in Reproductive Biology and contribute to the recruitment of other faculty.

Within the basic sciences in the School of Medicine, "Yana" has the distinction of thirty years of uninterrupted research funding from the National Institutes of Health (NIH). This record has been maintained even when NIH funding for basic research has been increasingly difficult to obtain. His success is due to his diligence in always being at the forefront of reproduction research. In addition, he is known nationally and internationally for his simple, elegant experiments which have produced breakthrough solutions of some serious human infertility problems.

Dr. Yanagimachi's major contribution was the first successful in-vitro capacitation of mammalian (hamster) sperm. The difficulty rested in the fact that mammalian sperm in the ejaculate cannot fertilize until they are transformed in the female reproductive tract through a process known as "capacitation". "Yana" developed a culture medium that included adequate amounts of calcium ions which produced sperm capacitation outside the female reproductive tract. The result involved membrane changes which caused the sperm to become hyperactive and gave them a new propulsive power needed to penetrate the egg's zona pellucida. Contact with the zona pellucida initiated the "acrosome reaction" which resulted in a selective loss of the sperm head's complex membrane system and exposed a special region on the sperm head. This region became the critical site for attachment and fusion with the egg's membrane. The sperm head was then brought into the egg's cytoplasm. This sperm head composed of genetic material expanded, became the male pronucleus and combined with its female counterpart, thereby completing the fertilization process.

Yana's achievement of in-vitro fertilization made detailed study of the sequential steps possible, using electron microscopy. Although each species had its own variation, the technique was soon applied to the animal breeding industry, including zoos. The use of in-vitro fertilization enabled a dramatic increase in the yield of genetically excellent livestock, as well as contributing to the preservation of endangered species. The initial success in the human, in England in 1978, is a direct outcome of Yana's earlier work.

Yana also continued to make other significant discoveries. He found the mechanism by which attachment of the sperm head to the egg surface changed the egg's membrane and prevented subsequent sperm from entering, thus avoiding polyspermy. In other experiments, he demonstrated that the zona pellucida controlled species specificity. When the zona was removed, cross-species fertilization was achieved.

In 1976, Yana made a remarkable discovery. Using the hamster and mouse, he found that he could bypass the requirements for sperm capacitation and acrosome reaction by microinjection of a single sperm directly into the egg. He showed that those processes were only related to getting the sperm head into the egg. These experiments reached the applied stage during the last decade. Fertility clinics frequently use this intracytoplasmic sperm injection technique (ICSI) in severe male related infertility. The use of microinjection in the fertilization process has indirectly contributed to the success of cloning in sheep, using the nucleus of a non-sperm cell.

Dr. Yanagimachi continues to lead the world in the field of fertilization. His current research focus lies in the question, "What about the male who cannot produce any sperm in the ejaculate?" He hopes to find some answers through exploring the potential of immature sperm obtained from the testis. He has shown that in mice, the microinjection of spermatids results in fertilization and the production of healthy offspring. He is proceeding to test earlier forms in the spermatogenic sequence.

His basic science achievements continue to be recognized nationally and internationally with medals and awards from the United Kingdom and prizes from the United States. At the University of Hawaii, he is recipient of the Medal for Excellence in Research from the Board of Regents. We look forward to his future successes and wait in anticipation to see ways in which his basic research in reproductive biology will continue to influence the practice of medicine.